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PRODUCTIVITY INCREASES THROUGH THE IMPLEMENTATION OF A SERVICE MANAGEMENT MODEL BASED ON LEAN SERVICE, MRP, AND SLP IN CLEANING AND PET CARE SERVICES SMEs

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Abstract

Research on implementing work standardization in an SME company in the veterinary sector is very scarce. This scientific article aims to increase productivity without neglecting the grooming service's quality and applying different engineering solutions to improve resource management. The results obtained can be of great value to similar industries, especially those that want to improve the performance of their operations, avoid waste, and improve their productivity. In companies such as a veterinary clinic, it is common to find that those in charge of the bathroom area do not perform an outstanding performance in their work, considering this task as not very important or definitive for the company, causing unnecessary delays, slow work speed, and unmotivated staff. We seek through this article to demonstrate that, through standardization of processes and areas within a company, the imperfections found can be significantly improved with a meager investment of money. This article refers to the implementation of the standardization of work in a veterinary clinic, achieving an increase of more than 30% in its productivity.

Keywords
Motion study, time study, standard time, productivity, SMEs

1. Introduction

This study focuses on the veterinary services sector, representing more than 100 billion dollars in the global market, with an annual growth of 4.68%. In Peru, almost 60% (4 million) of households have at least one pet, spending only on Grooming an average of 44 soles per month for each pet and an average of 150 soles, including food and baths. In Lima alone, more than 640 veterinarians and 374 pet stores serve more than 1.5 million in demand. In 2020, the turnover of veterinary services at the national level was almost 250 million soles, with a growth of nearly 20% compared to 2015. A good part of the small and medium-sized veterinary clinics that offer bathing or pet grooming carry out their activities a priori without knowing their results or indicators that guarantee the correct management of the activities and processes in their different areas. Many of these veterinarians have limitations in their technical capacity and resource management, without having control of their ability to perform services or productivity indicators, thus implying difficulty in keeping their costs low and quality standards high.

Likewise, this research aims to apply different engineering solutions not only to the country's veterinary sector but also to increase the SME sector's productivity at an international level. Therefore, the problem posed and the question to be answered is the following: How does the application of engineering and work standardization methods improve resource management and productivity in grooming service processes?

1.1 Objectives

As the main objective, this work aims to demonstrate that applying the engineering method and the standardization of work improves the grooming process in a veterinary company. First, the movements and times of the employees within the process will be identified. Subsequently, work standardization methods and SLP will be applied to improve unproductive times and reduce signs and downtime. Then, the MRP method will be applied to have better control over the production process. Finally, a flowchart of the grooming service and technical sheets were made to obtain adequate quality control in using materials for the service.

2. Literature Review

2.1 Study of times

According to Aguilar Escobar et al. (2020), time study is a work measurement technique used to obtain productivity standards or standard work times. It defines the standard of work as the time required by a team of workers to carry out a task, following a prescribed method, with an average level of effort and skill. According to Nakayama (2010), the standard time has conventionally been established through multiple techniques for work measurement, such as stopwatch time study and predetermined time systems. It was demonstrated through the study carried out that through the time study tool, more efficient and effective work can be achieved, considerably improving the productivity of different activities, highlighting the activities that took the most significant amount of time and demonstrating that although the use of this tool is limited, the need for a time study in service sectors such as tourism has become more apparent, considering its importance in the development of the modern industry. According to Krupesh et al. (2019), the time study is carried out to improve the working conditions, the work environment, and the worker's motivation in the same way. Likewise, according to Khekale et al. (2016), this type of study increases the satisfaction of the final customer, generating more excellent value for the company studied, considering its importance in the development of the modern industry. According to Krupesh et al. (2019), the time study is carried out to improve the working conditions, the work environment, and the worker's motivation in the same way. Likewise, according to Khekale et al. (2016), this type of study increases the satisfaction of the final customer, generating more excellent value for the company studied, considering its importance in the development of the modern industry. According to Krupesh et al. (2019), the time study is carried out to improve the working conditions, the work environment, and the worker's motivation in the same way. Likewise, according to Khekale et al. (2016), this type of study increases the satisfaction of the final customer, generating more excellent value for the company studied.

2.2 Work standardization

According to Realyvásquez-Vargas et al. (2019), using work standardization methodologies, studying the movements of workers, time, and redesign of workstations, efficiency and productivity rates can be increased. Once the tools above are applied, unnecessary activities are reduced, as well as the standard time of each position or work area of the process, which in turn increases the rate of production and productivity of each stage of the process. As mentioned by Ellingsen et al. (2007), the standardization of service work, as exemplified by nursing, provides a platform as it faces the inherent tension of trying to achieve a better quality of care while simultaneously enjoying efficiency gains. According to Bakkeli (2021). Carrillo et al. (2020) suggest that standardization based on Deming's continuous improvement approach can lead to a high increase in service levels and allow the company to provide for their processes greater reliability and sustainability.

2.3 Design Planning System (SLP)

Baca et al. (2021), in their present study, sought to increase productivity by addressing the leading causes that were identified as having a high downtime due to disorder in the area, delays due to poor work methods, and the absence of materials and supplies in the manufacturing process of furniture in SMEs. The tools applied were the System Layout Planning (SLP) to redistribute the work floor correctly. Furthermore, by using Standardization Work (SW), the processes and activities carried out by the operators were improved and the 5S improved the work environment of the company, allowing an increase in productivity. In conclusion, the implementation of the tools achieved its goal of increasing productivity because the production time of upholstered furniture was reduced by 42%. Quiroz et al. (2021) state that the design of a workstation has an enormous impact on productivity and work impact on the personnel's body.

2.4 Lean service + 5S

Valdivia et al. (2021), in their research work, sought to implement a management model based on Lean Service to reduce waste such as processes, delays, and transportation in a service company and, in this way, increase the effectiveness of Operating Processes applying tools such as 5S, Value Stream Mapping to identify cycle time and Standardized Work to improve efficiency and effectiveness. In conclusion, the efficiency of the service provision process in an MYPE company in the consulting sector increased by 28.44%, thanks to the management model based on Lean Service. Furthermore, according to Palomino et al. (2021), there are currently companies from different sectors that continue to operate traditionally; they are not using technology as a point of competitiveness within the market; therefore, these tools help to identify the problems that exist in the service process and achieve the desired objectives. Finally, the lean service tool in SMEs is to reduce waste, reprocessing, and costs and improve service quality since, in most cases, they do not manage the relationship with suppliers and customers, according to Torri et. (2021).

2.5 Material Requirement Planning

According to Iannone et al. (2009), the implementation of an MRP (Material Requirements Planning) system in a service such as a hospital service allows planning resources, facilities, and human resources according to the actual demand of the clients (patients), highlighting possible overloads and problems in the process. Likewise, it was confirmed that the logic of an MRP system could be applied to different service environments in addition to mass production industries, reducing investment in inventories and improving production planning with the correct amount of materials to be used. In the right place and at the right time. A study by Wiecek et al. (2020) concluded that applying an MRP reduces the cost of materials used. According to Carbajal et al. (2021), MRP techniques can increase service levels, reducing stock breaks, consumption, and sales cost losses.

3. Method

For this article, the type of research carried out is a case study. It is a detailed article on a specific topic, in this case, a company in the veterinary industry. Qualitative and quantitative methods have been used to study the company in question. According to Dul (2007), This type of study is used to describe, compare, evaluate, and understand different aspects of a research problem, whether it is an individual case study (of a single instance) or comparative (of multiple instances). According to Flyvbjerg, B. (2011), much of what is known empirically worldwide is thanks to case studies and their applications.

The research design is adjusted to a quasi-experimental investigation. This type of research is made up of a set of organized and technical activities that are carried out to collect the necessary information and data on the subject to be investigated and the problem to be solved, presented mainly through an unverified experimental variable, under controlled conditions, with the aim of to describe how or why a particular situation or event occurs, in this situation, within a veterinary clinic. According to Thyer (2012), quasi-experimental research defines a comparison between two situations: A situation with an element X applied against a situation in which it was not applied and thus find the effect of the variable X in the studied system. Likewise, a control group and a comparison group are mentioned. For this article, the established control group is the veterinary clinic before the changes are made, while the comparison group is after the improvements have been made. For the collection of the data required for the investigation, a non-probabilistic technique was used, in which the sample is not based on probabilities but causes related to the characteristics of the investigation.

When diagnosing the service process of the company, the existence of many downtimes can be identified, as well as delays in different phases of the process, which result in a very long average and standard time, with a very high downtime in the bathing area, as well as a very long delay in the process in the drying and "finishing" areas of the pets. It can be seen closely related to the time spent on their respective activities and inappropriate use of the material resources used in each of them. Likewise, the design of the area where the main processes are carried out has flaws. Although these are not very noticeable, they are mainly based on positioning some tools and materials necessary for each activity.

To diagnose the current veterinary situation, a tree diagram was developed that allowed us to identify the causes, consequences, and the main problem in the productivity of the SME under study.

The veterinary clinic conducts its operations based primarily on the experience gained during its years of service, which has steadily increased its sales. The problem encountered is that by continuing with an operational process guided solely by experience and without good order and standardization, the same efficiency can no longer be counted on, considerably reducing its operating capacity and increasing the costs required to perform its functions. Therefore, the clinic must consider its problems at each stage of its operational process to make the most of its tangible and intangible resources and generate more excellent value.

According to the analysis of the problem tree in the diagnosis phase, it was identified that the leading causes are the preliminary design of the workstations, the high rotation of the movements of the employees in the manufacturing area, and the excessive standard time of work time. Standard production. Therefore, it was found that the main problem, through the tree diagram made in the veterinary diagnosis, has been possible to identify the leading causes: Inefficient workforce, inefficient use of materials, and errors in the quality of the products. Services. Based on these causes, it was found that the main problems are the absence of work methodology, unproductive times, non-existent management of the operational process, as well as inadequate route management, thus implying inefficient management of the entire operating process. This is because there is no standardization of the time of each activity in the same way that there is no evaluation of the jobs and their operators, resulting in very low productivity compared to the bathing and grooming sector in veterinary clinics that offer this service. As Rehman et al. (2019) mention, standard time is the time it takes for a qualified and trained operator to complete a specific job while working in an efficient location, at a sustainable rate, using methods, tools, equipment, site arrangements specific work and working conditions. in the same way that there is no evaluation of the jobs and their operators, resulting in very low productivity compared to the bathing and grooming sector in veterinary clinics that offer this service. As Rehman et al. (2019) mention, standard time is the time it takes for a qualified and trained operator to complete a particular job while working in an efficient location, at a sustainable rate, using methods, tools, equipment, site arrangements specific work and working conditions. in the same way that there is no evaluation of the jobs and their operators, resulting in very low productivity compared to the bathing and grooming sector in veterinary clinics that offer this service. Rehman et al. (2019) mention that standard time is the time it takes for a qualified and trained operator to complete a particular job while working in an efficient location, at a sustainable rate, using methods, tools, equipment, site arrangements, specific work and working conditions.

Once the leading causes and problems of the veterinary have been identified, the solutions and tools to be applied to improve its productivity can be analyzed based on pertinent indicators that allow it to impact its operational process significantly. Therefore, it is expected that, through the application of the different techniques and tools used, the productive capacity of similar companies in the veterinary sector can be improved, effectively reducing the time required to carry out each activity, as well as the idle time of the different work areas found in the process.

The variables that have been identified that directly affect the productivity of the process are the distance between the workstation and the tools or materials required, the ability of each operator to perform each activity, the number of materials used for the use of each activity, and their waste, among other factors. By controlling these variables, the productivity of each activity can be effectively increased, thus reducing the cycle time of the entire operating process, thus improving the distribution of the area, reducing dead or inactive times, and increasing the speed with which it is carried out. In addition, each action has a high-quality standard for each part of the process.

As can be seen in Figure 1, a guide was developed for the methodology used during the analysis and execution:

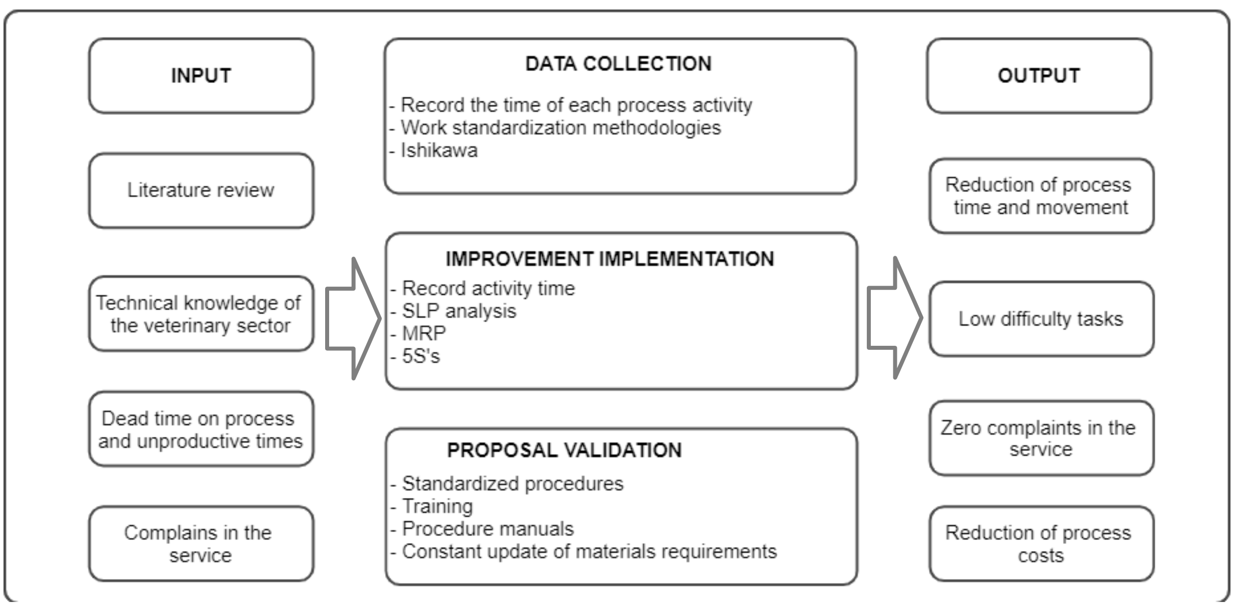

Figure 1. Proposed model

4. Company information

This research focuses mainly on SMEs in the veterinary industry, represented by a veterinary-pet shop in San Miguel - Lima - Peru. This veterinarian encounters problems in carrying out her services, mainly grooming, as she has long waiting times and processes. For this reason, this study aims to show the importance of the application of the Time Study and standardization of work, as well as the study of movement and management of inventories and materials. Through these tools, the veterinary services sector can optimize its processes and have greater productivity, being more effective and efficient in using its resources.

5. Initial Data Collection

Data collection consists of obtaining and measuring information from various sources that will allow a complete evaluation. A series of tools were used, such as surveys and interviews to receive information about the activities and techniques carried out in the service, the Ishikawa to see what the sequential effects of downtime, delay, and different causes are, and the Pareto to see the most important causes of delays and delay. Once all the information had been collected, it was determined that it was feasible to use the Work Standardization, SLP, and MRP tools. All these tools will be applied until the results are obtained. Figure 2 shows all the steps followed to obtain results from this research.

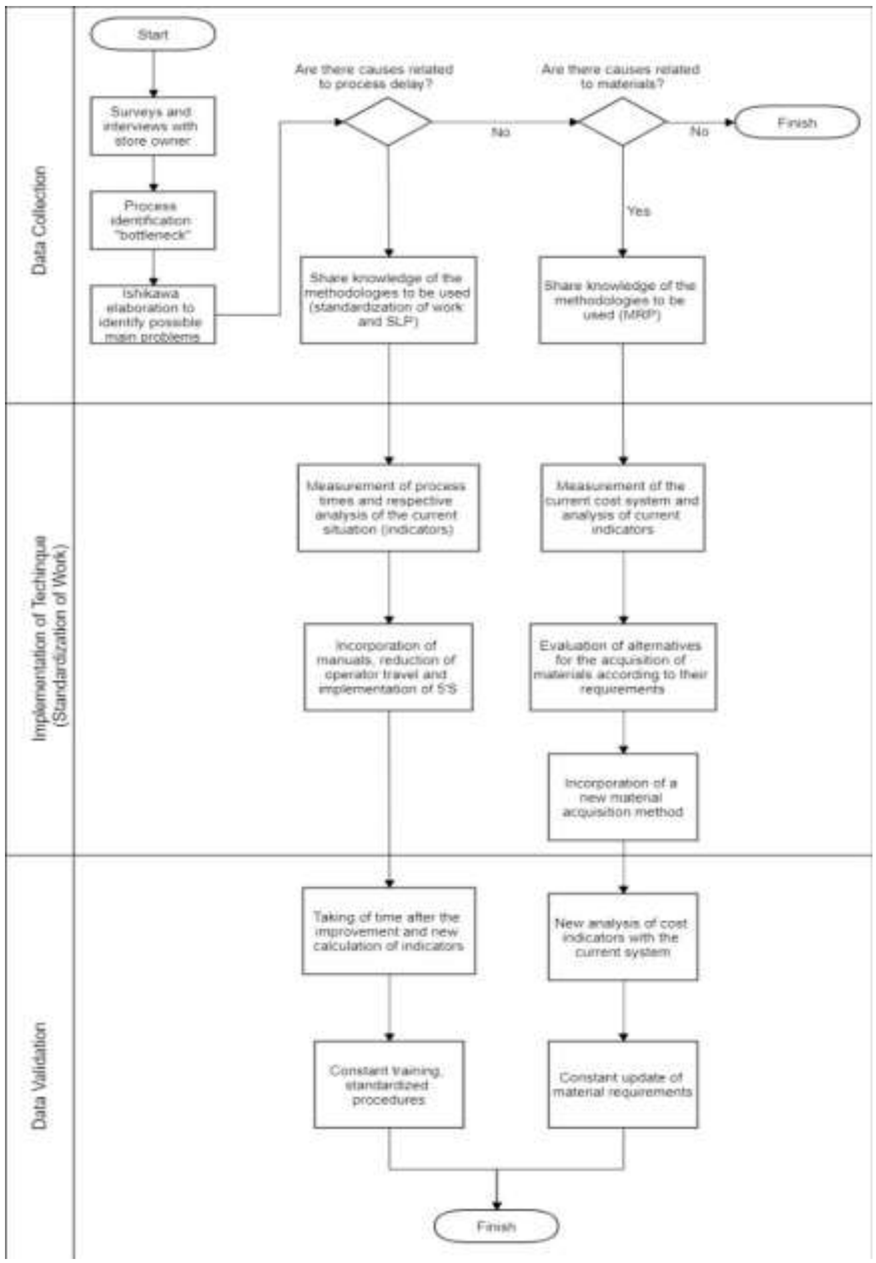

Figure 2. Research process

6. Implementation of standardization of work and planning of material requirements (MRP) and 5S

As shown in figure 3, the activities of the process were analyzed through a relationship diagram, where four (4) necessary processes, twelve (12) critical processes, and eleven (11) essential processes were observed. For the analysis of the diagram, it must be considered that the entire pet bathing process is carried out on the first floor with proper ventilation; that is, the roof is open. In addition, it is noted that operations are not close enough and whose location can be modified to optimize the pet bathing process.

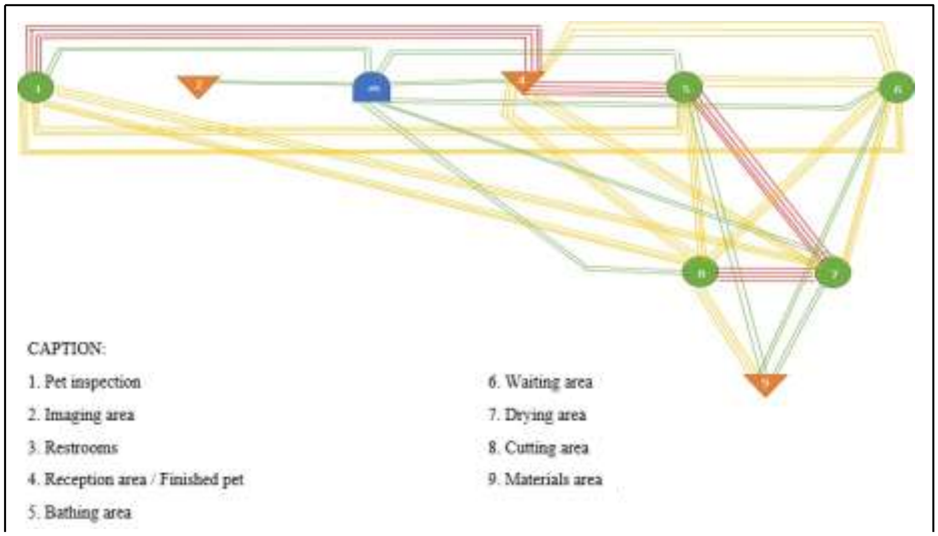

Figure 3. Relational diagram of activities (Before)

In Figure 4, the waiting area was modified, a movable cage located 3.4 meters from the bathtub; now, it is 1.6 meters between the bathing area and the drying area, where the distance was reduced by 52.94%.

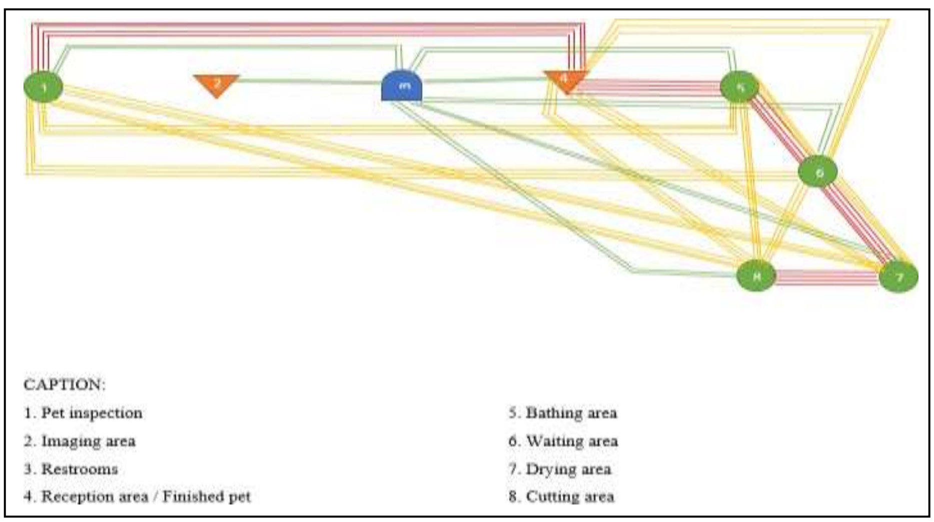

Figure 4. Relational diagram of activities (After)

Likewise, in the materials area, workers were trained that all materials used must be in each corresponding work area. According to Vizcarra et al. (2020), any application and implementation of a methodology will always be supported by training sessions for the workers who participate in the processes.

The 5S were applied where at the end of the pilot test, it can be seen in Figure 5 that the company obtained a result that is not so far from the expected ideal situation since, with the evaluation that we made previously, the workers were not very clear about their functions and were disorganized, wasted materials and most of the time their work tools were incomplete. For this reason, we carried out training and informed the supervisor and the workers of this methodology; we taught them different techniques of correct bathing for a pet. It was explained to them what each S consisted of, in the first place, Seiri, which is about identifying the necessary or unnecessary tools in your work area. The second is Seiton which tries to identify and organize things so that anyone can quickly locate them, which is why it was predetermined that before they start working, all the materials in the work areas and the correct preparation of the shampoo must be identified. The third is Seiso, which tries to keep the environment clean; for this reason, they were informed that all their tools must be cleaned after each use and maintain cleanliness in their work areas under the supervision of their immediate boss.The fourth is Seiketsu which focuses on the standardization of processes, where the staff must be aware of the importance of the previous 3S's. Finally, Shitsuke, which focuses on making those attitudes become a habit.

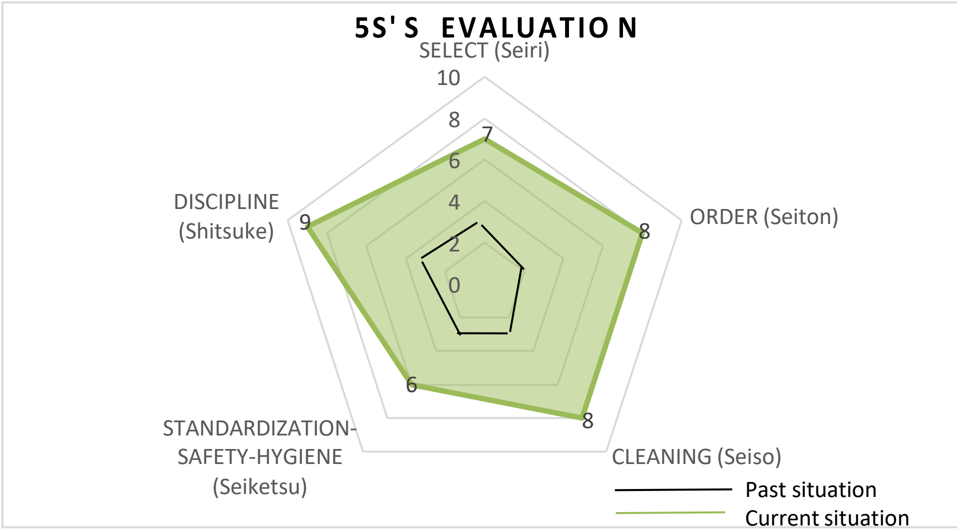

Figure 5. 5S Evaluation

For a correct diagnosis and application of engineering tools to an MYPE, it is necessary to analyze the standard time of the processes. As previously mentioned, the standard time is the actual time to perform a specific task, including compensation for fatigue and personal and unavoidable delays during daily tasks. Standard time is the time required by a fully qualified and trained operator working at a standardized pace and making an average effort to operate, using specific methods, tools, equipment, layout, and working conditions.

To obtain the standard time of the company under study, a time study was carried out for two months, which allowed us to obtain the average times of the different activities analyzed and, through relevant calculations, the standard time. As can been seen in the table 1, for the time study, the data was collected using a direct observation technique of the grooming employees with a stopwatch, with 30 observations. The participants in said data collection are the operators (2) and the head of the area (owner). Therefore, the work time was timed considering the operators' times, interruptions, and fatigue.

Through the study of times, as shown in Table 1, it was possible to find the time required for each operation in minutes. For the calculation of the standard time, a valuation factor of 1 is used for operators who work with a normal efficiency range, less than 1 for those who are in the learning stage, and greater than 1 for operators with more experience in the field. Unfortunately, before the time study, there was no record of an average or standard time for the activities carried out. There was only a general idea of the maximum time each activity should take to work correctly.

Table 1. Initial Standard-Times (Minutes)

Operation	Element	Average	Normal	Standard
1	Preparation	0.69	0.69	0.81
2	Soaking	0.43	0.43	0.51
3	Shampoo (Cleaning)	1.94	1.75	2.05
4	Rinsing	1.68	1.51	1.77
5	Air Blowing	1.41	1.27	1.49
6	Drying	10.29	9.26	10.83
7	Ear cleaning	3.15	2.84	3.32
8	Brushing	11.19	10.07	11.78
9	Cut and file nails	1.93	1.74	2.04
10	Haircut (Optional)	8.28	7.46	8.72
11	Final arrangements	0.56	0.56	0.66
	TOTAL	**41.57**	**37.58**	**43.97**

After obtaining the average activity time, each operator was assigned an individual assessment to obtain the normal time. Then the standard time was calculated based on the gaps present (17%).

Numerical analysis of time and costs

In order to define how many services, the company produces daily, the following has been considered:

1. Being a process carried out individually by each operator from start to finish, the average service execution time is given by the total sum of the standard times of each activity, being a cycle time of 43 minutes and 58 seconds.
2. The effective working hours (Discounting Lunches) are 5 hours in total.

Given these considerations, we proceed to calculate the productive capacity of the company:
Time = 5 hours/day x 60 minutes/hour = 300 minutes/day (Per Operator)
Production = 300 minutes/day ÷ 43.97 minutes/service = 6.82 daily services per operator
With the current production capacity per operator, with two active operators, a maximum of 13 services per day can be achieved. Next, Table 2 shows the unitary costs of the process:

Table 2. Initial Costs of the Process (In Soles for each Service)

Material	Quantity	Units	Cost	Unit cost	Requirement x Dog	Units	Cost x Dog
Cotton	1000	grams	33	0.033	2.5	grams	0.083
Shampoo	4	liters	121	30,250	0.08	liters	2,420
Cologne	150	milliliters	8	0.053	0.75	milliliters	0.040
Ribbons	10	meters	2.5	0.250	0.7	meters	0.175
Electricity (Dryer)	1	kWh	0.84	0.840	0.17	Hours	0.143
Water	1000	liters	7.3	0.007	20	liters	0.146
Workforce	1	Hour	6	6,000	0.74	Hours	4,440
						Total	**7,446**

6.1 Results

The application of the respective changes regarding the time of manual work of the personnel was carried out for one month, providing guidelines and work techniques that could alter the time required for each activity, considering that the quality of the service must be equal or higher. It is important to emphasize that there have been no complaints from clients regarding the bathing and grooming service results in the pilot test period. The results of the pilot test are shown in the Table 3.

Table 3. Pilot Test Standard-Times (Minutes)

Operation	Element	Average	Normal	Standard
1	Preparation	0.44	0.44	0.52
2	Soaking	0.27	0.27	0.31
3	Shampoo (Cleaning)	1.53	1.53	1.79
4	Rinsing	1.58	1.58	1.85
5	Air Blowing	1.29	1.29	1.51
6	Drying	7.94	7.94	9.29
7	Ear cleaning	2.84	2.84	3.33
8	Brushing	7.12	7.12	8.33
9	Cut and file nails	2.36	2.36	2.76
10	Haircut (Optional)	7.59	7.59	8.88
11	Final arrangements	0.82	0.82	0.95
-	**TOTAL**	**33.77**	**33.77**	**39.51**

With the new times found after the improvement proposed to the veterinary studied, we can calculate the new productive capacity, remembering that the following must be considered:

1. Being a process carried out individually by each operator from start to finish, the average service execution time is given by the total sum of the standard times of each activity, the new cycle time of 39 minutes and 31 seconds.
2. The effective working hours (Discounting Lunches) are 5 hours in total.

Given these considerations, we proceed to calculate the productive capacity of the company:

Time = 5 hours/day x 60 minutes/hour = 300 minutes/day (Per Operator)
Production = 300 minutes/day ÷ 39.51 minutes/service = 7.59 daily services per operator
With the new production capacity per operator, with two operators currently active, a maximum of 15 services per day can be achieved. Next, Table 4 shows the new unit costs of the process:

Table 4. New Costs of the Process (In Soles for each Service)

Material	Quantity	Units	Cost	Unit cost	Requirement x Dog	Units	Cost x Dog
Cotton	1000	grams	33	0.033	2.5	grams	0.083
Shampoo	4	liters	121	30,250	0.04	liters	1,210
Cologne	150	milliliters	8	0.053	0.75	milliliters	0.040
ribbons	10	meters	2.5	0.250	0.7	meters	0.175
Electricity (Dryer)	1	kWh	0.84	0.840	0.15	Hours	0.126
Water	1000	liters	7.3	0.007	fifteen	liters	0.110
Workforce	1	hour	6	6,000	0.66	Hours	3,960
						Total	**5,703**

6.2 Cost analysis

Through the data analysis, a cost-benefit of 1.74 soles was observed for each completed cycle, implying a substantial decrease in the long-term costs of these operations. This result is considered high since the investment required for its implementation is nil, as it only consists of theoretical-practical engineering techniques and tools for its application, without the need to acquire machinery, tools, or additional materials to those that the veterinary clinic you already have at your disposal in the Grooming area.

6.3 Validation

The proposed model was validated through the implementation of a pilot test with a duration of 1 month, analyzing a total of 20 services throughout May and June 2022.

Through the data obtained from the pilot test, regular and drastic changes can be observed in the indicators to be taken into consideration: Daily attention capacity and productivity of the grooming area.
Attention capacity: Maximum pets to attend per day.
Productivity (Based on cost): Number of pets served for each sol spent.

In the calculation of the initial attention capacity, there was a maximum capacity of **13 pets attended** by the daily grooming area. This implied a limit in attention capacity on days with a more significant workload in which the clinic owner would have to stop receiving bathroom and grooming requests, resulting in a loss of income for the company. However, as can be seen, through the improvements in time, thanks to the standardization of time, techniques, and use of materials that the bathing and grooming area received, it was possible to increase its attention capacity **by 11.29%**, thus allowing the veterinarian to be able to carry out two additional daily grooming services, resulting in up to an additional income of 420 soles per week only in bathroom services, under normal conditions.

Regarding productivity, initially, each sol of cost allowed to carry out **0.1343 services**, while, after making time improvements, allowing a lower cost of labor for each service, as well as the improvement in the use of materials (mainly shampoo, which incurred much waste due to lack of standardization), managed to increase this indicator **to 0.1753, implying a productivity increase of 30.53% for each PEN spent, under normal conditions.**

7. Conclusions

The analysis carried out on the Peruvian veterinary company that performs pet bathing and grooming services successfully met the goals set for this article, whose main task was to demonstrate that, through engineering tools such as work standardization, requirement planning of materials, SLP, and the 5S, a substantial improvement in the functions of a production process can be achieved. However, it is essential to detail that to achieve the stated objectives, the workforce must continue respecting the work standardization guidelines that were provided to them on techniques, completion time, cleaning, and preparation, as well as establishing a continuous improvement of themselves and the

company's processes in order to achieve better performance in the medium and long term.
Finally, the company also has areas outside the bathrooms and grooming, such as the administrative area and customer service, which can present substantial opportunities for improvement that will allow this veterinarian to have a higher rate of acceptance and perceived value on the part of its clients, workers, and even suppliers.

References

Aguilar-Escobar, V.G., Garrido-Vega, P., Majado-Márquez, J., & Camuñez-Ruiz, J.A. (2021). *Hotel room cleaning: Time study and analysis of influential variables in a Spanish hotel*. Journal of Industrial Engineering and Management, 14(3), 645-660. https://doi.org/10.3926/jiem.3441

Baca J., Sánchez F., Castro P., Marcelo E., Alvarez J. C. *Mejora de la productividad en empresas de un clúster de muebles de madera en Perú.* Revista Internacional de Tendencias de Ingeniería y Tecnología, 69(10), 97-107. https://doi.org/10.14445/22315381/IJETT-V69I10P213

Bakkeli, V., & Breit, E. (2022). *From "what works" to "making it work": A practice perspective on evidence-based standardization in frontline service organizations*. Social Policy & Administration, 56(1), 87–102. https://doi.org/10.1111/spol.12757

Carbajal, G., Lopez, C., Viacava, G., Quiroz, J. (2021). *Reducción de residuos en restaurantes de comida rápida*. En Simposio Brasileño de Tecnología (pp. 419-426). https://doi.org/10.1007/978-3-030-75680-2_47

Carrillo, A., Tarazona, E., Quiroz, J., & Viacava, G. (2020). *Modelo de optimización de procesos Lean para mejorar los tiempos de procesamiento y aumentar los niveles de servicio utilizando un enfoque Deming en una empresa textil de redes de pesca*. En Simposio Brasileño de Tecnología (pp. 443-451). Springer, Cham. https://doi.org/10.1007/978-3-030-75680-2_50

Dul J., & Hak T. (2008), *Case study methodology in business research.* Butterworth-Heinemann. (pp. 197-207).

Ellingsen, G., Monteiro, E., & Munkvold, G. (2007). *Standardization of work: co-constructed practice*. The Information Society, 23(5), 309-326. https://doi.org/10.1080/01972240701572723

Iannone, R., Pepe, C., & Riemma, S. (2009, January). *An MRP-based Architecture to Plan Resources and Manage Waiting Queue in Hospital Systems*. In Proceedings of the International Conference on Health Informatics (pp. 478-483). https://doi.org/10.5220/0001551104780483

Khekale SN., Askhedkar RD., Parikh RH. & Devesh G. (2017). *Role of time study in the emergency department of an Indian hospital for quality health care.* Asian Journal of Pharmaceutical and Clinical Research, vol. 10, no. 1, Jan. 2017, pp. 55-58. https://doi.org/10.22159/ajpcr.2017.v10i1.9616

Krupesh C. & Rushabh S. (2019). *Application of time and motion study for performance enhancement of building construction industry.* International Journal of Innovative Technology and Exploring Engineering, Vol. 8(9), 980-984. https://doi.org/10.35940/ijitee.I1158.0789S19

Nakayama S., Nakayama K. & Nakayama H. (2002) *A study on setting standard time using work achievement quotient*. International Journal of Production Research, 40:15, 3945-3953. https://doi.org/10.1080/00207540210159581

Palomino V. P., Raffo S. y Fernando J. L., (2021) "*Agile Logistics Management Model to Reduce Service Times and Improve Processes Using Lean Service Methodology in Companies in the Electrical Sector*," 2021 10th International Conference on Industrial Technology and Management (ICITM), pp. 78-83. https://doi.org/10.1109/ICITM52822.2021.00022

Quiroz, J, Aquino, D, Rodríguez, E, & Montoya, M (2020). *Rediseño del Espacio de Trabajo Mediante un Modelo Ergo-Lean para la Reducción de Trastornos Musculoesqueléticos en Pymes del Sector Complementos de Vestir.* Revista internacional de tendencias y tecnología de ingeniería, (12), 163-174. https://doi.org/10.14445/22315381/IJETT-V69I12P219

Realyvásquez-Vargas A, Flor-Moltalvo FJ, Blanco-Fernández J, Sandoval-Quintanilla JD, Jiménez-Macías E, García-Alcaraz JL. (2019) *Implementation of Production Process Standardization - A Case Study of a Publishing Company from the SMEs Sector*. Processes. 2019; 7(10):646. https://doi.org/10.3390/pr7100646

Rehman, A., Ramzan, M. B., Shafiq, M., Rasheed, A., Naeem, M. S., & Savino, M. M. (2019). *Productivity improvement through time study approach: a case study from an apparel manufacturing industry of Pakistan*. Procedia

Manufacturing, 39, 1447-1454. https://doi.org/10.1016/j.promfg.2020.01.306

Thyer B. (2012). *Quasi-Experimental Research Designs.* Oxford University Press Inc https://doi.org/10.1093/acprof:oso/9780195387384.001.0001

Torri, M., Kundu, K., Frecassetti, S. y Rossini, M. (2021), *"Implementación de lean en una empresa de PYME de TI: un caso italiano"*, International Journal of Lean Six Sigma, vol. 12 núm. 5, págs. 944-972. https://doi.org/10.1108/IJLSS-05-2020-0067

Valdivia, G., & Rivas, J., (2021) *Modelo de gestión basado en lean service para incrementar la efectividad de los procesos operativos en una empresa de servicios*. 19th LACCEI International Multi-Conference for Engineering, Education and Technology, Virtual Editiion, July 19-23. https://doi.org/10.18687/LACCEI2021.1.1.405

Vizcarra, O., Sotelo, F., Raymundo, C., Domínguez, F. (2020). *Modelo de Mejora de Procesos de Postventa Aplicando Lean Thinking para Reducir los Tiempos de Entrega de Vehículos en una Empresa de Automoción*. En: Ahram, T., Karwowski, W., Pickl, S., Taiar, R. (eds) Ingeniería y diseño de sistemas humanos II. IHSED 2019. Avances en sistemas inteligentes y computación, vol 1026. Springer, Cham. https://doi.org/10.1007/978-3-030-27928-8_134

Więcek, D., Więcek, D., & Dulina, L. (2020). *Materials requirement planning with the use of activity-based costing.* Management systems in Production Engineering, vol. 28 (1), pp. 3-8. https://doi.org/10.2478/mspe-2020-0001

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Juan Carlos Quiroz-Flores holds an MBA from Universidad ESAN. Industrial Engineer from Universidad de Lima. Ph.D. in Industrial Engineering from Universidad Nacional Mayor de San Marcos, Black Belt in Lean Six Sigma. He is currently an undergraduate professor and researcher at the University of Lima. Expert in Lean Supply Chain and Operations with more than 20 years of professional experience in the direction and management of operations, process improvement, and productivity; specialist in implementing Continuous Improvement Projects, PDCA, TOC, and Lean Six Sigma. Leader of transformation, productivity, and change generation projects. Able to form high-performance teams aligned with the company's "Continuous Improvement" strategies and programs. He has published articles in journals and conferences indexed in Scopus and Web of Science. His research interests include supply chain and logistics management, lean manufacturing, lean six sigma, business process management, agribusiness, design work, facility layout design, systematic distribution planning, quality management, Industry 4.0, Digital Transformation, and Lean Manufacturing. He is a classified researcher by the National Council of Science, Technology and Technological Innovation of Peru (CONCYTEC), as well as a member of IEOM, IISE, ASQ, IEEE, and CIP (College of Engineers of Peru).

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